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發明專利說明書 574430

一、發明名稱	中文	精密電鑄方法及裝置
	英文	Manufacturing method and device for precision electroforming
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四、中文發明摘要 （發明之名稱：精密電鑄方法及裝置）

本發明在於提供一種精密電鑄方法及裝置，乃將預定之氣體灌入電鑄槽之槽室中形成一加壓力，以相對加壓於電鑄槽之槽室，使其內之電鑄液保持在預定之壓力下進行電鑄加工，進而有效抑制氫氣泡之產生，以改進鍍層厚度之均勻性與鍍層之結晶細緻化，增進材料結構強度與導電性，提高極精密加工品質。

英文發明摘要 （發明之名稱：Manufacturing method and device for precision electroforming）

The invention includes a precision electroforming method and device. The pre-determined gas is filled into the electroforming tanks with certain pressure. The electroforming process is practiced in the pressured electrolyte. It can control gas formation in the electroforming process, improve the thickness uniformity of work pieces, and fine crystalline of deposited materials. It also increase the material strength and conductive through this invention. It provides the extreme

四、中文發明摘要 （發明之名稱：精密電鑄方法及裝置）

英文發明摘要 （發明之名稱：Manufacturing method and device for precision electroforming）

high prccision machining quality.

本案已向

國(地區)申請專利	申請日期	案號	主張優先權
無			

有關微生物已寄存於

寄存日期	寄存號碼
無	

五、發明說明（1）

本發明與一種平面及具深寬比鍍件母模加工成金屬模仁、模具有關，更詳而言之，特別是指將電鑄槽槽室中之壓力提高進行電鑄加工，以有效改進鍍層厚度之均勻性與鍍層之結晶細緻化，增進材料結構強度與導電性之一種精密電鑄方法及裝置。

按，精密電鑄（或稱微電鑄）加工如同傳統電鍍原理一樣，其主要是將金屬沉積於具有導電層之鍍件母模上，以得到立體形狀之金屬模具或模仁，進一步作為大量生產之器具，最典型的如CD碟片、小型顯示器背光板、光纖被動元件或電腦周邊設備之模仁、模具或元件等。目前電鑄加工方法，主要是將一鍍件母模置於一電鑄槽之陰極導電端，一可溶性之電鍍金屬則置於陽極導電端，電鑄槽之槽室中填充有電鑄液並淹蓋至鍍件母模及電鍍金屬上，之後，電鑄液通予電流，使帶正電的金屬離子游向陰極導電端並獲取電子而沉積於鍍件母模上形成金屬沉積層，而電鑄中失去的金屬離子則由陽極導電端之電鍍金屬補充者。

惟，一般電鑄的鍍件母模的型式概可分成平面鍍件及具深寬比結構之鍍件，一般平面鍍件之電鑄加工係針對以其表面為電鑄基底，而深寬比結構之鍍件則係針對極為微小之毛細管孔道內壁為電鑄基底，其中，不論鍍件結構為何，其電鑄加工過程都是在常壓中進行，且過程中容易產生氫氣泡並滯留於陰極導電端之鍍件母模表面，是以，電鑄過程中如果氫氣泡由鍍件母模表面移除的速率小於金屬沉積層之成長速率時，氫氣泡將會被包裹在金屬沉積層中

五、發明說明（2）

，導致鍍件母模之表面形成多數之氫氣鑄孔，尤其在其各面接續之邊緣、邊角部份更是粗糙不平整，佈滿的更多的氫氣鑄洞，雖然，可以利用降低電流密度，以減少氫氣泡的產生，但相對的電鑄的時間則會大大增加，無法符合經濟效益，難為產業所接受，加工後之品質亦難謂為理想。

另、針對深寬比結構之鍍件母模而言，由於電鑄表面係在其毛細管之孔道內壁，該孔道之尺寸非常的微細，尤其深寬比例約在50左右或以上之微結構，如管徑 120 μm，高度為6 mm 之鍍件母模，習用電鑄加工方法根本難以達到電鑄加工之要求，主要原因，係該孔道管徑甚微，且其一端是封閉的，是以，孔道內部氣體的壓力因電鑄液的毛細作用進入孔道時，會相對壓縮其內部之氣體，導致孔道內之壓力逐漸變大，直到毛細作用力與孔道內部氣體平衡為止，以致於該電鑄液根本無法達到孔道之底部，電鑄加工之電流密度在孔道底部分佈不均，致使該金屬沉積層無法到達沉積於孔道之底部，當然表面電鑄加工之精密度及效果即變的很差者。

有鑑於此，本案發明人乃積其多年從事於相關產品開發、製造之經驗，秉持精益求精之精神，不斷研究、改良，終於有了本發明之誕生者。

即，本發明之主要目的在於提供一種精密電鑄方法及裝置，係將預定之氣體滲入電鑄槽之槽室中，以形成一加壓力相對加壓於電鑄槽之槽室，使其內之電鑄液保持在預定之壓力下進行電鑄加工，進而有效抑制氫氣泡之產生，

五、發明說明 (3)

以改進鍍層厚度之均勻性與鍍層之結晶細緻化，增進材料結構強度與導電性，提高極精密加工品質。

圖式中各標號之意義：

10---電鑄槽	20---供給筒	30---過濾器
40---壓力產生器	50---加熱器	60---電鑄液
70---鍍件母模	80---電鍍金屬	90---抽氣裝置
100--抽氣裝置	11---槽室	12---攪拌器
13---陽極導電端	14---陰極導電端	111--輸出口
112--輸入口	113--導管	114--導出口
121--通孔	21---通道	22---控制閥
31---濾心	32---輸入管	33---連接管
34---輸出管	35---泵浦	41---出氣管路
42---加壓管	43---通氣管路	
51---溫度控制箱	52---加熱棒	53---感溫線
71---基板	72---毛細管	721--孔道

首先，請配合圖一所示，本發明較佳實施例中之一種精密電鑄裝置，係包含有一電鑄槽10、一供給筒20、二組過濾器30、一壓力產生器40及一加熱器50，其中：

該電鑄槽10，內部為一中空密閉之槽室11，該槽室11係供電鑄液60容置其中，且該槽室11底部位置上設有一攪拌器12，內部並設有相對應之一陽極導電端13及一陰極導電端14；

五、發明說明（4）

該供給筒20，係設於該電鑄槽10之上方，其下方設有一通道21與該電鑄槽10之槽室11相通，該通道21上定設有一控制閥22，以相對控制電鑄液60由此注入於電鑄槽10之槽室11中；

該過濾器30，共設有二組，係與電鑄槽10相鄰設置，其內係各設有一濾心31，該濾心31可採用一般濾心、活性碳濾心或兩者組合等搭配，藉以過濾電鑄液60中之雜質使用，其第一組過濾器30一側設有一輸入管32與電鑄槽10槽室11底部之一輸出口111連接相通，另側則設有一連接管33與第二組過濾器30相接連通，該第二組過濾器30之輸出管34再與電鑄槽10槽室11底部之一輸入口112連接相通，同時，該第二組過濾器30之輸出管34間並設一泵浦35，藉此利用該泵浦35作動時，將電鑄液60由輸入管32抽吸引導至各組過濾器30中並經過其濾心31，由輸出管34再輸出導入於電鑄槽10之槽室11中，完成過濾，同時，該槽室11中再設一導管113與該輸入口112相接連通，該導管113並延伸預定高度，使其頂端之導出口114略高於槽室11中容置之電鑄液60上方，俾將已過濾之電鑄液60重新輸入於電鑄槽10中；

該壓力產生器40，為一空氣壓縮機，係設於電鑄槽10之旁側，其一出氣管路41係連接一加壓管42與電鑄槽10之槽室11相通，俾藉由該加壓管41將預定之空氣（如氮氣）輸入於槽室11中，以提供相對之氣體壓力於槽室11，使該槽室11中保持預定之壓力加壓於該電鑄液60者；同時，該出

五、發明說明 (5)

氣管路41之旁側再分設有一通氣管路43，該通氣管路43與該槽室11底部設置之攪拌器12相連通，藉以提供預定之氮氣由該攪拌器12之通孔121 中噴出，以相對攪拌該電鑄液60形成噴流狀，俾令其過程中電鑄作用更為均勻者；

該加熱器50，係安裝於電鑄槽10之槽室11中，其包含有一溫度控制箱51、一加熱棒52及一感溫線53，該加熱棒52及感溫線53係相對延伸組裝於槽室11中，藉以相對控制電鑄液60之溫度保持在攝氏20-80度間者。

其次，請配合圖二所示，本發明較佳實施例中之一種精密電鑄方法，其加工步驟方法如下：

(a) 將已製作完成之一鍍件母模70置於該電鑄槽10之密閉槽室11中，並將其固接於一陰極導電端14上，之後，再將可溶性之一電鍍金屬80固接於一陽極導電端13上；

請再配合圖三所示，本實施例中之鍍件母模70係採用為具有深寬比結構之鍍件，即該鍍件母模70係以預定之金屬片作為基板71，該基板71上再依預定功能排列固設有多數具中空孔道721 之毛細管72，本實施例中毛細管72之管徑為120 μm，高度為12 mm，深寬比為100，另，其電鑄加工時，請配合圖三(A) 所示，首先，將該鍍件母模70置於一真空罐90中，並利用一抽氣裝置100 將真空罐90內之空氣抽離呈真空狀態，之後，將電鑄液60徐徐注入於真空罐80中直到掩蓋於鍍件母模70上，繼續，將該真空罐90打開回復至常壓狀態，此時，請配合圖三(B) 所示，由於該毛細管72之孔道721 內已無空氣阻力，是以，該電鑄液60

五、發明說明 (6)

即可完全順利的填滿於該毛細管72的孔道721 中，而無空氣阻力之作用，繼續，再將該鍍件母模70取出置於電鑄槽10之槽室11中，並夾置於陰極導電端14上。

(b) 打開供給筒20之控制閥22，將電鑄液60徐徐注入於該電鑄槽10之槽室11中，直到電鑄液60掩蓋於鍍件母模70及電鍍金屬80上方，即可停止；另，該電鑄液60中係添加有潤濕劑，以降低電鑄液60之表面張力。

(c) 啟動該壓力產生器40提供適當之氮氣，使該氮氣經由加壓管12灌入於電鑄槽10之槽室11中加壓，令該電鑄槽11槽室11之電鑄液60得以保持預定之壓力下，該壓力係為鍍壓壓力約為4kg/cm2較佳；

(d) 在上述壓力下進行電鑄，使電鑄液60中之金屬離子游向陰極導電端並獲取電子而沉積於鍍件母模70上形成金屬沉積層，完成加工者。

上述即為本發明主要電鑄方法及裝置，其中，本發明主要是利用一壓力產生器40作用於電鑄槽10之槽室11，使該槽室11中之壓力提高保持至常壓以上，俾令該鍍件母模70得於在高於常壓之壓力下施予電鑄加工，如此，其在電鑄過程中，由於，該等電鑄液60受到較高的壓力作用，相對的其表面張力大幅降低，更提高了相對之潤濕性，進而使電鑄液60能夠更快速的滲入於氫氣泡與鍍件母模70表面之間，有效且快速的將氫氣泡由鍍件母模70之表面移除，去除了氫氣泡產生的影響，相對使該電鑄加工後表面金屬沉積層之厚度均勻更佳及結晶更細緻化，而不會有氫氣鑄

孔的產生，進而有效增進材料結構整體之強度者。

另，一般深寬比結構之鍍件母模70，本發明於電鑄時係先將其孔道721 中之空氣抽取且填入電鑄液60，因此，在電鑄加工過程中，孔道721 中因無氣體壓力之阻礙，且該電鑄液60又受到電鑄槽10槽室11中高壓力之加壓作用，是以，該電鑄液60可以完全的充填於孔道721 中並進行電鑄加工，如此，該金屬沉積層完全的到達沉積於孔道 721 底部，有效提高深寬比結構在電鑄加工精密度及效果，對於深寬比100 以上或更高的結構，更可達到其精密電鑄加工目的者。

最後，本發明在應用實施上，由於可有效的提高電鑄加工之精密度及產品結構強度，因此，可廣泛運用極精密產品之加工及製造，如下：

(1) 半導體製程中的銅製程，作為儀器開發用途。

(2) 用於微模具之電鑄加工設備，具有實質的品質提升。

(3) 於電腦週邊設備之製造設備，可提供高品質的電鍍成品。

(4) 可用於光纖被動元件之模具製造設備，生產精密度極佳之模具。

(5) 對於生醫器材所需之模板，可有效提供精確之製程設備。

綜上所述，本發明不但極具產業上利用價值，並已達到突破精密電鑄加工之高度技術，同時，遍查國內外相關

五、發明說明 (8)

此類技術資料及文獻亦未發現有相同或近似技術存在，是以，本發明誠已符合發明專利要件，爰依法提起申請。

惟，上述所揭露之圖式、說明，僅為本發明較佳實施例，本發明當可廣泛應用於各種精密電鑄加工製程及裝置上，是以，當不能以此限制本實施例之範圍，即，大凡熟悉此項技藝之人士，其依本發明精神範疇所做之修飾或等效實施之變化，仍應包含在本案之申請專利範圍中。

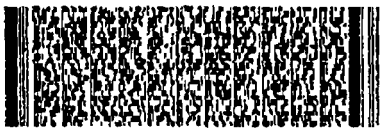
圖式簡單說明

第一圖係本發明較佳實施例中精密電鑄裝置之外觀示意圖。

第二圖係本發明較佳實施例中精密電鑄方法之流程示意圖。

第三圖(A)係本發明較佳實施例中鍍件母模置於真空罐中抽氣之簡易示意圖。

第三圖(B)係本發明較佳實施例中鍍件母模置於真空罐中填入電鑄液之簡易示意圖。



1. 一種精密電鑄方法，係包含：

(a) 將已製作完成之一鍍件母模置於一密閉之電鑄槽之槽室中，並將其固接於一陰極導電端上，而一電鍍金屬則固接於一陽極導電端上；

(b) 將預定之電鑄液注入於電鑄槽之槽室中，直到電鑄液掩蓋於鍍件母模及電鍍金屬上方；

(c) 將預定之氣體灌入電鑄槽之槽室中，形成一加壓力以相對加壓於電鑄槽中，使其內之電鑄液保持在預定之壓力下；

(d) 在上述預定壓力下進行電鑄，使電鑄液中之金屬離子游向陰極導電端並獲取電子而沉積於鍍件母模上形成金屬沉積層，完成加工者。

2. 依申請專利範圍第1 項中所述之精密電鑄方法，其中，該鍍件母模為一平面鍍件，該平面鍍件表面係經由磨平、拋光、清洗等加工程序製成鍍件母模。

3. 依申請專利範圍第1 項中所述之精密電鑄方法，其中，該鍍件母模為一具有深寬比結構之鍍件，即該鍍件母模係以預定之金屬片作為基板，該基板上再依預定功能排列固設有多數具中空孔道之毛細管，且該毛細管管徑及高度之深寬比為1-1000之間，另，其電鑄加工時，先將該鍍件母模置於一真空罐中，利用一抽氣裝置將真空罐內之空氣抽離呈真空狀態，之後，將電鑄液徐徐注入於真空罐中直到掩蓋於鍍件母模上，繼續，將該真空罐打開恢復常壓狀態，此時，該毛細管之孔道內已無空氣阻力，是以，該

六、申請專利範圍

電鑄液可完全填滿於該毛細管的孔道中，之後，將鍍件母模取出置於電鑄槽之槽室中，並夾置於陰極導電端上。

4. 依申請專利範圍第1 項中所述之精密電鑄方法，其中，該電鑄槽內係外接一壓力產生器，藉以將氮氣灌入於電鑄槽中加壓，使該電鑄槽之電鑄液保持預定之壓力。

5. 依申請專利範圍第1或4項中所述之精密電鑄方法，其中，該電鑄槽中之壓力係指錶壓壓力介於0.1-10kg/cm2之間。

6. 依申請專利範圍第1 項中所述之精密電鑄方法，其中，該電鑄液中係可添加有潤濕劑，以降低電鑄液之表面張力。

7. 一種精密電鑄裝置，係包含：

一電鑄槽，內部為一中空密閉之槽室，該槽室係供電鑄液容置其中，且該槽室底部位置上設有一攪拌器，內部並設有相對應之一陽極導電端及一陰極導電端；

一供給筒，設有通道及控制閥與電鑄槽相通，以提供電鑄液注入於電鑄槽中；

一過濾器，與電鑄槽相鄰設置，其內設置有濾心，以過濾雜質使用，另，其一側設有一輸入管係與電鑄槽槽室底部之一輸出口連接相通，另側則設有一輸出管與電鑄槽槽室底部之一輸入口連接相通，該輸出管間並設一泵浦，藉此利用該泵浦將電鑄液由輸入管引導至過濾器中並經過濾心後，由輸出管再輸出導入於電鑄槽之槽室中，同時，該槽室中再設一導管與該輸入口相接連通，該導管並延伸

六、申請專利範圍

預定高度，使其頂端之導出口略高於槽室中容置之電鑄液上方；

一壓力產生器，設於電鑄槽之旁側，其出氣管路上連接有一加壓管與電鑄槽之槽室相通，藉由該加壓管將預定氣體輸入於槽室中，以提供相對之氣體壓力於槽室，使槽室中保持預定之壓力加壓於該電鑄液者。

8. 依申請專利範圍第7 項中所述之精密電鑄裝置，其中，該壓力產生器為一空氣壓縮機者。

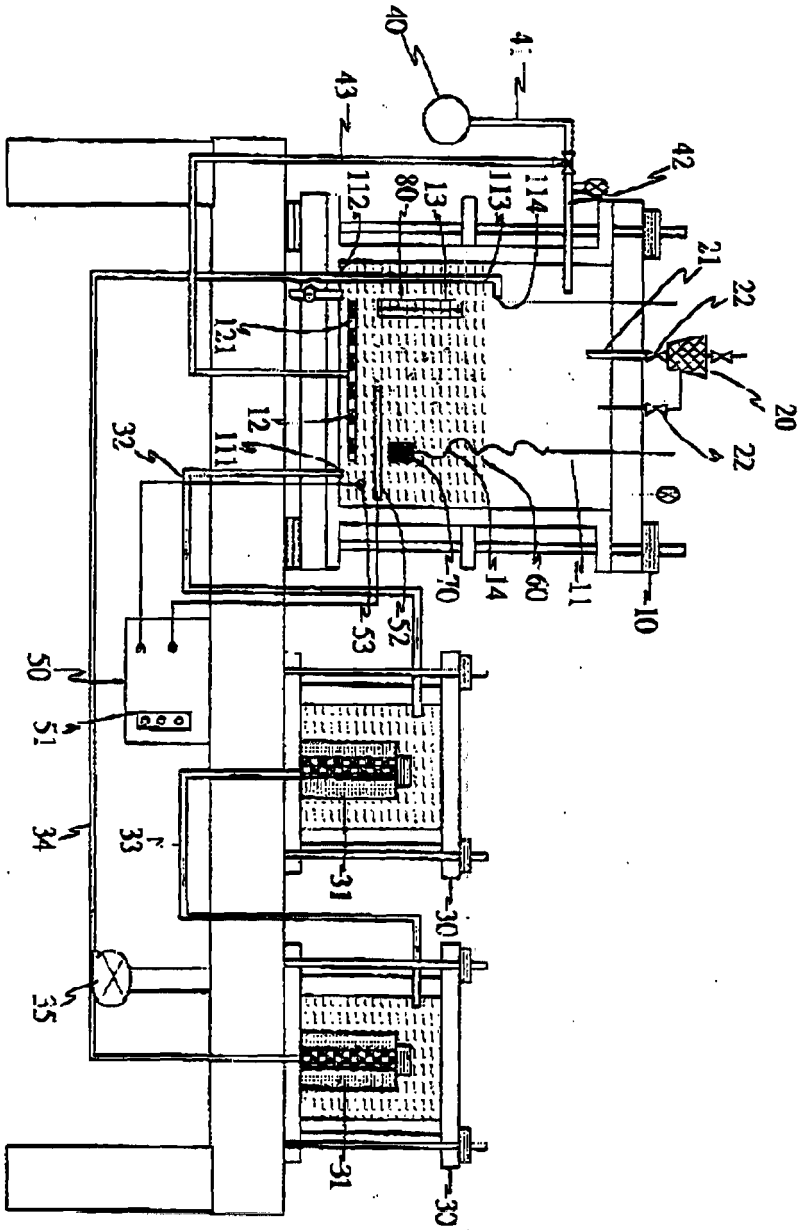
9. 依申請專利範圍第7或8項中所述之精密電鑄裝置，其中，該壓力產生器之出氣管路旁側係再分設有一通氣管路，該通氣管路與該槽室底部設置之攪拌器相連通，藉以提供預定之空氣由該攪拌器之通孔中噴出，以相對攪拌該電鑄液者。

10. 依申請專利範圍第7項中所述之精密電鑄裝置，其中，該過濾器係由兩組串接而成，每組均設有濾心，其間係以一連接管相接通通，俾以雙重過濾該電鑄液者。

11. 依申請專利範圍第7或10項中所述之精密電鑄裝置，其中，該過濾器之濾心為活性碳濾心。

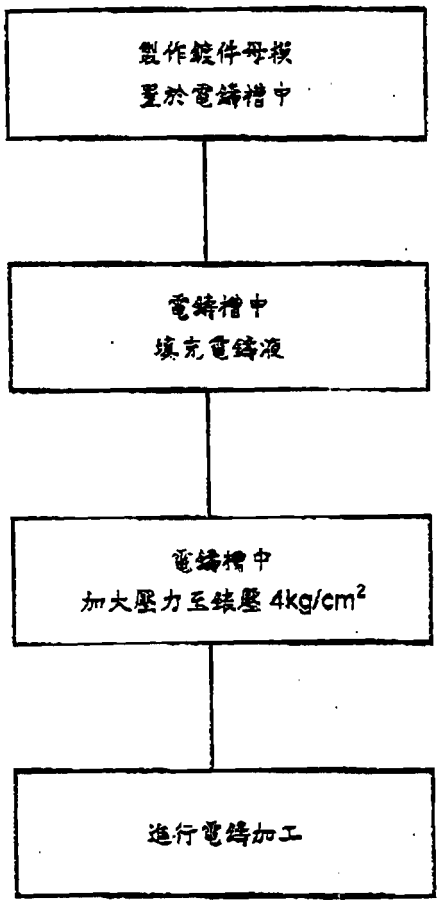
12. 依申請專利範圍第7項中所述之精密電鑄裝置，其中，該電鑄槽之槽室中係設有一加熱器，該加熱器包含有一溫度控制箱及一加熱棒及一感溫線，以相對控制電鑄液之溫度保持在攝氏20-80度間者。

公告本



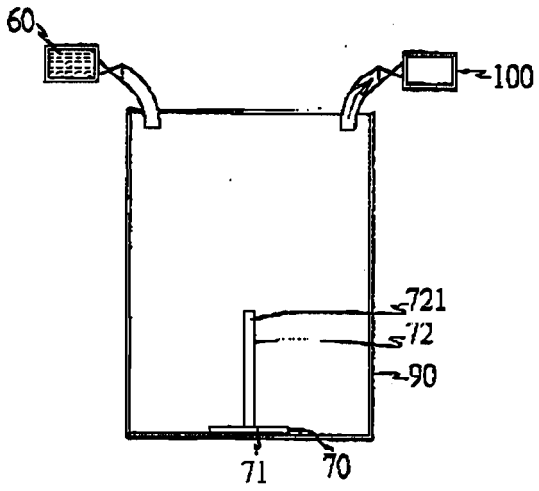
第一圖

圖式

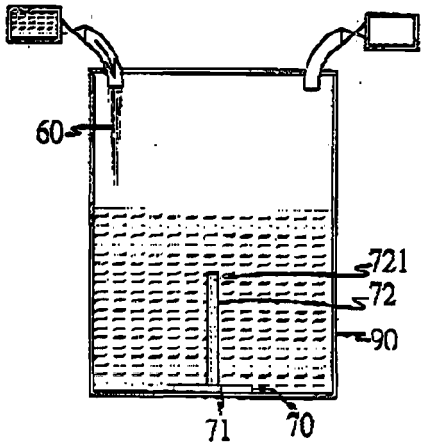


第二圖

圖式



第三圖 A



第三圖 B

TITLE: DEVICE AND METHOD FOR PRECISION

BACKGROUND OF THE INVENTION

(a) Technical Field of the Invention

The present invention generally relates to electroforming, and more particularly to a device and a related method where the electroforming process is conducted under a raised pressure.

(b) Description of the Prior Art

Precision electroforming is a manufacturing process similar to the conventional electroplating where metallic material is deposited over the conductive surface of a mold substrate. The highly precise electroformed parts can be further utilized as molds in the mass production of, for example, the compact disks, backlight plates of small-scale display devices, optical fiber passive components, or PC peripherals. Within the existing electroforming environment, the mold substrate is positioned on the cathode terminal while a dissolvable metallic material is positioned on the anode terminal of an electroforming tank where both the mold substrate and the metallic material are both immersed in an electrolyte. Then, electrical current is conducted through the electrolyte and metallic deposition is built up on the surface of the mold substrate as positive metallic ions of the electrolyte swim towards the cathode terminal and obtain electron there. The metallic ions of the electrolyte

are re-supplied by the metallic material on the anode terminal.

The mold substrates can be roughly categorized into two types: planar substrates and those having high-aspect-ratio structures. For planar substrates, the metallic deposition is formed on the surface of the substrate. For the substrates having high-aspect-ratio structures, the metallic deposition usually has to be formed at the bottom and on the inner wall of channels or bores of the substrate. Regardless of the types of the mold substrates, a conventional electroforming process is usually conducted under the normal atmospheric pressure.

On the other hand, hydrogen bubbles are commonly formed and retained on the surface of the mold substrate during the conventional electroforming process. Therefore, when the deposition speed is higher than the speed of removing the hydrogen bubbles, the bubbles will be buried inside the deposition, causing a large number of cavities on the deposition surface, especially around the edges and corners. Even though reducing the electrical current is a feasible way to reduce the amount of hydrogen bubbles, the time to complete the electroforming is inevitably lengthened correspondingly, which is not an economical option. The quality of the electroformed parts is also inferior.

For mold substrates having high-aspect-ratio (e.g., over *50)* structures, the

deposition usually has to be formed deeply into tiny channels of the mold substrate. The conventional electroforming device or method is not applicable as, when the electrolyte enters the channels through the capillary effect, the air trapped inside the channels will prevent the electrolyte to reach the deepest spot of the channels and therefore no deposition will be developed there. The precision of the electroformed parts is therefore significantly impaired.

SUMMARY OF THE INVENTION

Accordingly, a device and a related method are provided herein to obviate the foregoing shortcomings of the conventional electroforming process.

A major characteristic of the device and method of the present invention lies in raising the pressure inside the electroforming chamber above the normal atmospheric pressure when the electroforming is conducted. Under this higher pressure, the electrolyte can quickly permeate between the surface of the mold substrate and the hydrogen bubbles. The hydrogen bubbles, as such, can be effectively and quickly removed. Without the influence of the hydrogen bubbles, the electroformed metallic deposition has a more uniform thickness and finer grains. The material strength and conductivity of the electroformed parts are also significantly increased.

The foregoing object and summary provide only a brief introduction to the present invention. To fully appreciate these and other objects of the present invention as well as the invention itself, all of which will become apparent to those skilled in the art, the following detailed description of the invention and the claims should be read in conjunction with the accompanying drawings. Throughout the specification and drawings identical reference numerals refer to identical or similar parts.

Many other advantages and features of the present invention will become

manifest to those versed in the art upon making reference to the detailed description and the accompanying sheets of drawings in which a preferred structural embodiment incorporating the principles of the present invention is shown by way of illustrative example.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG 1 is a schematic diagram showing the various components of an electroforming device according to an embodiment of the present invention.

FIG 2 is a flow diagram showing the processing steps of an *5* electroforming method according to an embodiment of the present invention.

FIG 3A is a schematic diagram showing the mold substrate is pre-processed in a vacuumed case according to the present invention.

FIG 3B is a schematic diagram showing the electrolyte is filled into the vacuumed case of FIG 3A according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following descriptions are exemplary embodiments only, and are not intended to limit the scope, applicability or configuration of the invention in any way. Rather, the following description provides a convenient illustration for implementing exemplary embodiments of the invention. Various changes to the described embodiments may be made in the function and arrangement of the elements described without departing from the scope of the invention as set forth in the appended claims.

As illustrated in FIG 1, a device for precision electroforming according to 10 an embodiment of the present invention contains a hollow tank member 10, a supply tube 20, two filtering members 30, a pressure generation member 40, and a heating member *50*.

Inside the tank member 10, a closed chamber 11 is provided, inside which the electrolyte 60 is stored. Also inside the chamber 11, an anode terminal 13, a cathode terminal 14, and an agitation element 12 is provided. The agitation element 12 is positioned adjacent to the bottom surface of the chamber 11.

The supply tube 20 is positioned above tank member 10 and is conducted to the chamber 11 via a channel 21. A control valve 22 is provided along the channel 21 so as to control the injection of the electrolyte 60 into the chamber 11.

Each of the filtering members 30 has a core 31 for filtering the impurities of the electrolyte 60. The core 31 can be an ordinary one commonly found in filtration devices, one made of active carbon, or a combination of the above. A first filtering members 30 has an incoming tube 32 connected to an outlet 111 opened at the bottom of the chamber 11, and a connection tube 33 connected to a second filtering member 30. The second filtering member 30 in turn has an outgoing tube 34 connected to an inlet 112 opened at the bottom of the chamber 11. A pump 35 is provided along the outgoing tube 34so as to draw electrolyte 60 from the chamber 11 via the incoming tube 32, the first and second filtering members 30, the outgoing tube 34, and then back into the chamber 11. As the electrolyte 60 flows through the filtering members 30, it is filtered by the cores 31 of the filtering members 30. Further inside the chamber 11, a connection tube 113 is provided whose one end is connected to the inlet 112 and is extended upward so that the other end 114 of the connection tube 113 is slightly above the electrolyte 60. As such, the filtered electrolyte 60 is refilled into the tank member 10.

The pressure generation member 40 such as an air compressor is positioned to a side of the tank member 10. An output pipe 41 is connected to the chamber 11 via a pressurizing tube 42, which introduces a pre-determined gas (e.g., nitrogen) into the chamber 11 **50** as to exert a pre-determined

pressure on the electrolyte 60 inside the chamber 11. The output pipe 41 is branched to the agitation element 12 via a connection pipe 43 so that the pre-determined gas can be spurted from the holes 121 configured on the agitation element 12. The electrolyte 60 is therefore stirred into streams and the electrodeposition can be built up more evenly.

The heating member 50 contains a temperature control element 51 positioned outside the tank member 10. A heating rod 52 and a temperature sensor wire 53 are extended from the temperature control element 51 into the chamber 11. By the feedback of the temperature sensor wire *53,* the temperature control element 51 heats the heating rod 52so as to maintain the temperature of the electrolyte 60 between 20°C and 80°C.

As illustrated in FIG 2, the steps in conducting precision electroforming according to an embodiment of the present invention are as follows.

Firstly, a mold substrate 70 and a dissoluble metallic material 80 are positioned inside the chamber 11 and connected to the cathode terminal 14 and the anode terminal 13 respectively.

The mold substrate 70 in the present embodiment is an object having high-aspect-ratio structures. The mold substrate 70 contains a metallic plate as base 71. On top of the base 71, a capillary tube 72 having a number of pre-determined openings 721 is erected. The capillary tube 72 is 120 um in

width and 12 mm in height, and therefore has an aspect ratio of 100. Before the mold substrate 70 is placed inside the chamber 11, it is put through a preliminary process as shown in FIG 3A. As shown, the mold substrate 70 is placed inside a closed case 90 and the closed case is vacuumed by an aspiration device 100. Then the electrolyte 60 is filled inside the vacuumed case 90 until the mold substrate 70 is completely immersed as shown in FIG 3B. As the openings 721 contain no air inside, the electrolyte 60 will fill up every opening 721. Then, the mold substrate 70 is placed inside the chamber 11 and connected to the cathode terminal 14.

Please refer to FIG 2 again. Then, the control valve 22 is opened so that the electrolyte 60 is poured into the chamber 11 via the supply tube 20 until the electrolyte 60 rises above the mold substrate 70 and the metallic material 80. Please note that wetting agents can be added into the electrolyte 60 so as to reduce the surface tension of the electrolyte 60.

The pressure generation member 40 is then engaged to introduce an appropriate amount of nitrogen into the chamber 11 via the pressurizing tube 42 so that the electrolyte 60 is under a constant pressure which is between 0.1~10 kg/cm^2 and preferably around 4 kg/cm^2.

Finally, the electroforming is conducted under the above-mentioned pressure to form metallic deposition on the surface of the mold substrate 70.

Based on the foregoing description, the major characteristic of the device and method of the present invention lies in the use of a pressure generation member in raising the pressure inside the chamber 11 above the normal atmospheric pressure when the electroforming is conducted. Under this higher pressure, the surface tension of the electrolyte 60 is reduced and the wetting property of the electrolyte 60 is thereby enhanced. The electrolyte 60 therefore can quickly permeate between the surface of the mold substrate 70 and the hydrogen bubbles. The hydrogen bubbles, as such, can be effectively and quickly removed. Without the influence of the hydrogen bubbles, the electroformed metallic deposition has a more uniform thickness and finer grains. The material strength and conductivity of the electroformed parts are also significantly increased.

Another major characteristic of the present invention lies in the filling of the electrolyte 60 into the channels 721 in a vacuumed environment. Therefore, during the subsequent electroforming process, in addition to the higher pressure exerted, the deposition can be successfully formed from the deepest spot of the channels 721. For structures having high-aspect-ratio such as more than 100, the present invention can still achieve highly precise electroforming.

The present invention can be applied to the following fields for manufacturing products or molds requiring high precision: (1) copper

deposition in semiconductor production process; (2) micro-mold formation; (3) PC peripherals; (4) high-precision molds for optical fiber passive components; and *(5)* high-precision molds for biomedical products.

While certain novel features of this invention have been shown and described and are pointed out in the annexed claim, it is not intended to be limited to the details above, since it will be understood that various omissions, modifications, substitutions and changes in the forms and details of the device illustrated and in its operation can be made by those skilled in the art without departing in any way from the spirit of the present invention.

I CLAIM:

1. A precision electroforming method, comprising the steps of:

placing a mold substrate and a metallic material inside a closed chamber of an electroforming tank and connecting said mold substrate and said metallic material to a cathode terminal and an anode terminal respectively;

filling said chamber with an electrolyte until said mold substrate and said metallic material are immersed in said electrolyte;

filling a gas into said chamber and maintaining a pre-determined pressure on said electrolyte; and

performing an electroforming process by conducting electrical current through said electrolyte via said cathode and anode terminals.

2. The precision electroforming method according to claim 1, wherein said mold substrate is a planar substrate.

3. The precision electroforming method according to claim 1, wherein said mold substrate having a plurality of capillary tubes and said capillary tubes have an aspect ratio between 1-1000.

4. The precision electroforming method according to claim 1, further comprising the following steps before placing said mold substrate

into said chamber:

placing said mold substrate in a vacuumed space;

filling said vacuumed space with said electrolyte until said mold substrate is immersed in said electrolyte; and

opening said vacuumed space so that said electrolyte and said mold substrate are exposed to normal atmospheric pressure.

5. The precision electroforming method according to claim 1, wherein said pre-determined pressure is between 0.1 ‘—1 0 kg/cm^2.

6. The precision electroforming method according to claim 1, wherein said electrolyte contains a wetting agent for reducing the surface tension of said electrolyte.

7. A precision electroforming device comprising:

a tank member having a closed chamber where an electrolyte is stored, a cathode terminal and an anode terminal inside said chamber, and an agitation element inside said chamber and adjacent to the bottom surface of said chamber;

a supply tube conducted to said chamber via a channel, a control valve being provided along said channel so as to control the supply of said electrolyte into said chamber;

a second filtering member having a core for filtering impurities, an

incoming tube connected to an outlet of said chamber, an outgoing tube connected to an inlet of said chamber, and a pump provided along said outgoing tube so as to draw said electrolyte from said chamber via said incoming tube, said second filtering member, said outgoing tube, and then back into said chamber; and

a pressure generation member having an output pipe connected to said chamber via a pressurizing tube so as to introduce a pre-determined gas into said chamber and maintain a per-determined pressure inside said chamber and against said electrolyte.

8. The precision electroforming device according to claim 7, wherein said pressure generation member is an air compressor.

9. The precision electroforming device according to claim 7, wherein a connection pipe is branched from said output pipe to said agitation element so that said pre-determined gas is spurted from a plurality of holes of said agitation element.

10. The precision electroforming device according to claim 7, further comprising a first filtering member positioned between said second filtering member and said chamber along said incoming tube of said

second filtering member so as to provide additional filtering.

11. The precision electroforming device according to claim 7, wherein said core of said filtering member is made of active carbon.

12. The precision electroforming device according to claim 7, further comprising a heating member having a temperature control element positioned outside said tank member, a heating rod, and a temperature sensor wire wherein said heating rod and said temperature sensor wire are both extended from said temperature control element into said chamber so as to maintain the temperature of said electrolyte between 20°C and 80°C.

ABSTRACT OF THE DISCLOSURE

A major characteristic of the device and method of the present invention lies in raising the pressure inside the electroforming chamber above the normal atmospheric pressure when the electroforming is conducted. Under this higher pressure, the electrolyte can quickly permeate between the surface of the mold substrate and the hydrogen bubbles. The hydrogen bubbles, as such, can be effectively and quickly removed. The electroformed metallic deposition thereby has a more uniform thickness and finer grains.